

WHAT IS CLAIMED IS:

1. An electrolyte composition for depositing a tin alloy on a substrate, comprising tin ions, ions of one or more alloying metals, an acid, a thiourea derivative, and an additive selected from alkanol amines, polyethylene imines, alkoxylated aromatic
5 alcohols, and combinations thereof.
2. The composition of claim 1, wherein the ions of one or more alloying metals are selected from the group consisting of silver ions, copper ions, bismuth ions, and combinations thereof.
3. The composition of claim 1, wherein the ions of one or more alloying
10 metals comprise silver ions.
4. The composition of claim 3, wherein the ions of one or more alloying metals further comprise copper ions or bismuth ions.
5. The composition of claim 1, wherein the thiourea derivative comprises 1-allyl-2-thiourea or 1,1,3,3-tetramethyl-2-thiourea.
- 15 6. The composition of claim 1, wherein the additive comprises an alkanol amine.
7. The composition of claim 1, wherein the additive comprises a polyethylene imine.
8. The composition of claim 1, wherein the additive comprises an
20 alkoxylated aromatic alcohol.
9. The composition of claim 1, further comprising an antioxidant compound.
10. A method of depositing a tin alloy on a substrate, comprising contacting the substrate with the electrolyte composition of claim 1 and passing a current through the electrolyte composition to deposit the tin alloy on the substrate.
- 25 11. The method of claim 10, wherein the substrate is an electronic component selected from the group consisting of lead frames, semiconductor wafers, semiconductor packages, components, connectors, contacts, chip capacitors, chip resistors, and printed wiring boards.

12. The method of claim 10, wherein the ions of one or more alloying metals are selected from the group consisting of silver ions, copper ions, bismuth ions, and combinations thereof.

13. The method of claim 11, wherein the ions of one or more alloying metals
5 comprise silver ions.

14. The method of claim 10, wherein the thiourea derivative comprises 1-allyl-2-thiourea or 1,1,3,3-tetramethyl-2-thiourea.

15. A method of forming an interconnect bump on a semiconductor device, comprising:

- 10 (a) providing a semiconductor die having a plurality of interconnect bump pads;
- (b) forming a seed layer over the interconnect bump pads;
- (c) depositing a tin-alloy interconnect bump layer over the interconnect bump pads by contacting the semiconductor die with the electrolyte composition of claim 1 and
15 passing a current through the electrolyte composition to deposit the tin alloy interconnect bump layer on the substrate; and
- (d) reflowing the interconnect bump layer.

16. The method of claim 15, wherein the ions of one or more alloying metals are selected from the group consisting of silver ions, copper ions, bismuth ions, and
20 combinations thereof.

17. The method of claim 16, wherein the ions of one or more alloying metals comprise silver ions.

18. The method of claim 17, wherein the ions of one or more alloying metals further comprise copper or bismuth ions.

25 19. The method of claim 15, wherein the thiourea derivative comprises 1-allyl-2-thiourea or 1,1,3,3-tetramethyl-2-thiourea.

20. The method of claim 15, wherein the additive comprises a polyethylene imine.